ELECTRODEPOSITION OF BRONZE COATINGS FROM PYROPHOSPHATE-TRILONATE ELECTROLYTE

Maizelis A.V., Ovcharenko G.V.
National Technical University
«Kharkiv Polytechnic Institute», Kharkiv

Increase of reliability and durability of machines, mechanisms, apparatuses and devices is an actual problem for their consumers and an actual task of their manufacturers. There is a need in corrosion-resistant and simultaneously wear-resistant coatings with low friction coefficient. The copper-tin alloy coatings, both low-tin ("yellow bronze") and high-tin ("white bronze") bronzes are among wear-resistant antifriction coatings. Bronze coatings are used for decorative purposes, in soldering,. as a sublayer, in metal mirror manufacture, electrical contacts coating, in worn bronze parts restoration.

Toxic stannate-cyanide electrolyte is mainly uses in the industry. Scientists developed non-cyanide electrolytes: pyrophosphate, phenolsulfonic, tripolyphosphate, tetrafluoroborate, sulfate, sulfamate and perchlorate electrolytes [1]. However, the rate of coatings deposition in this electrolytes is low, thick coatings (that are uniform in composition) cannot be deposited from this electrolytes. Moreover, the electrolytes are chemically unstable.

The conditions of stabilization of pyrophosphate-trilonate electrolyte composition were revealed based on the study of dynamics of redox processes in electrolyte containing Cu (I), Cu (II), Sn (II), Sn (IV) compounds. The kinetic parameters of copper codeposition with tin are determined by cyclic voltammetry and using rotating disk electrode. Parameters of contact exchange of copper and tin ions of electrolyte with a steel surface are calculated. It is shown that the contact exchange occurs in the potentials zone of compact coating deposition and can be used for open-circuit formation of alloy layers.

It is determined that the coatings with "yellow bronze" are alloys of "solid solution" type. The microhardness value of the resulting bronze coatings (170-200 HV) is higher than the microhardness of the metallurgical "yellow bronze". The microhardness increases with increase of tin content in alloy. Minor spread in values of microhardness of coatings deposited in the current density range of 5-18 A dm^{-2} and over the samples surface indicates the stability of composition and physico-chemical properties of the coatings. Low internal stress measured using flexible cathode method makes it possible to deposit thick coatings (about 300 μm) to restore the surface of worn bronze parts. Coatings obtained on the surface of carbon steel and alloyed steel do not exfoliate after tests by application of scratches and thermal shock.

Reference:

1. V. V. Bondar', V. V. Grinina, V. N. Pavlov Jelektroosazhdenie dvojnyh splavov (Itogi nauki i tehniki) (Electrodeposition of binary alloys (Results of Science and technology). – 1979. – V. 16. – 329 p.